Transarterial Guglielmi Detachable Coils Embolization with Stenting for the Treatment of a Traumatic Carotid Cavernous Fistula

- Case Report -

Jung Yong Ahn, M.D.,[1] Hun Kyu Choi, M.D.,[1]
Byung-Hee Lee, M.D.,[2] Eun Wan Choi, M.D.[2]

Departments of Neurosurgery,[1] Radiology,[2] Pundang CHA Hospital, Pochon CHA University, Sungnam, Korea

Embolization of a carotid cavernous fistula(CCF) by means of a detachable balloon is a well-established method for treating CCFs while preserving a patent parent internal carotid artery(ICA). However, failure to embolize the CCF may occur on a few occasions. Herein we describe a stent-assisted Guglielmi detachable coil embolization that completely occludes the fistulous opening rather than fills the cavernous sinus. By applying this technique, we successfully treated a CCF, without compromise of the parent ICA in patients who has failed with balloon technique previously.

KEY WORDS : Carotid cavernous fistula · Embolization · Stenting.

Introduction

Direct carotid cavernous fistulas are commonly treated via the transarterial endovascular approach with detachable balloons[1]. However, failure to embolize the carotid cavernous fistula(CCF) may occur on a few occasions, such as when the balloon cannot pass through the fistula into the cavernous sinus by blood flow, or when the inflated balloon in the cavernous sinus retracts to the carotid artery[7]. In cases of technical failure, transvenous embolization with detachable balloons, standard platinum coils, liquid adhesives, or particulate agents, such as silk sutures, are usually the next treatment option, although this is not always possible because of a lack of vascular access[2,5,8].

Guglielmi detachable coils have been indroduced as an alternative method for treating aneurysms[4]. In addition, use of intracranial stents for aneurysm reconstruction holds great promise for success, particularly in the proximal larger vessels of the Circle of Willis in cases of unruptured aneurysms[6]. We report our early experience with stent-assisted guglielmi detachable coil(GDC) embolization of a CCF failed in balloon embolization.

Case Report

A 45-year-old man sustained a closed head injury as a result of a motor vehicle accident two months ago and developed the right ocular symptoms including of diplopia, exophthalmos, and conjunctival injection one month ago. On physical examination, a loud cranial bruit was audible, especially over the right eye. There was proptosis of the right eye with conjunctival congestion and chemosis ; visual acuity was slightly reduced(6/12), but ocular movements and the fundus were normal. Digital subtraction angiography revealed a direct fistula between the cavernous segment of the right internal carotid artery(ICA) and the cavernous sinus, with early and retrograde opacification of the right superior ophthalmic vein and inferior petrosal sinus(Fig. 1). Balloon embolization of the CCF was the first line of treatment, but failed due to acute angle of the fistulous portion. Thereafter, coil embolization was attempted with stent placement into the right internal carotid artery for inhibiting coil protrusion into the parent artery. An 8-F MPA guiding catheter(Cordis Endovascular Systems, Inc., Miami, FL) was positioned in the distal cervical segment of the left ICA. The fistulous portion of the right cavernous ICA crossed with a 0.014-inch, hydrophiliccoated wire(Wizdom ; Cordis Endovascular Systems, Inc., Miami, FL). Then, a 4×18-mm S670 stent(Arterial Vascular Engineering, Inc., Santa Rosa, CA) was advanced over the wire and deployed by inflating the balloon to 6-8 atm gradually(Fig. 2A). After stent placement, the microwire was navigated with roadmapping

Fig. 1. A preoperative angiogram reveals a direct fistula between the cavernous segment of the right internal carotid artery(ICA) and the caver-nous sinus, with early and retrograde opacification of the right superior ophthalmic vein and inferior petrosal sinus.

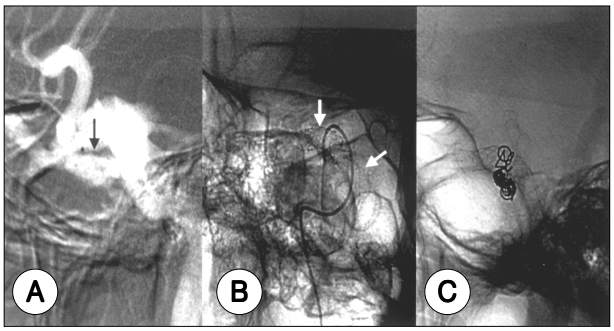

Fig. 2. Stent-assisted GDC embolization for carotid cavernous fistula. A 4×18-mm S670 stent(Arterial Vascular Engineerinc, Inc., Santa Rosa, CA ; dark arrow) is advanced over the wire and deployed by inflating the balloon to 6 - 8 atm×3 times(A). After stent(white arrow) placement, the microwire is navigated with roadmapping techniques through the fistula into the cavernous sinus(B). After the position of the catheter tip is secured in the cavernous sinus, one GDC-10 measuring 6mm×10cm and two fibered GDC-18 measuring 2mm×4cm(Target therapeutics, Fremont, CA) is introduced through stent pore into the cavernous sinus(C).

techniques through the fistula into the cavernous sinus(Fig. 2B). Selective angiograms were obtained through the guiding catheter once it was positioned in the cavernous sinus. After the catheter tip was secured in the cavernous sinus, one GDC-10(6mm×10cm) and two fibered GDC-18(2mm×4cm)(Target therapeutics, Fremont, CA) were introduced through stent pore into the cavernous sinus(Fig. 2C). Repeat angiography confirmed complete fistula closure with preservation of the parent vessel. Chemosis and proptosis were improved considerably and the bruit was extinguished. Follow-up at 12 months showed continued improvement with resolution of all symptoms, stable position of the coils and stent on angiography(Fig. 3).

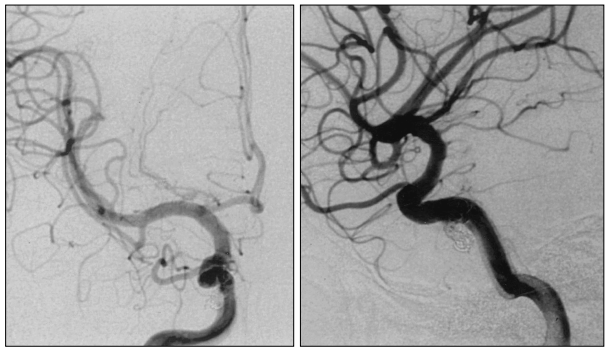

Fig. 3. Postoperative angiograms. Follow-up at 12 months shows stable position of the coils and stent on angiography.

Discussion

Embolization of a CCF by means of a detachable balloon is a well-established method for treating CCFs while preserving a patent parent ICA[1]. The size of the cavernous sinus and the fistula may affect the success rate of detachable balloon embolization of a CCF[9]. The cavernous sinus must be large enough to accommodate the detachable balloon/balloons for embolization. The size of the fistula must be smaller than the inflated balloon, but large enough to allow access for a deflated or partly inflated balloon. However, the size of the fistula should not be too large, because the embolization balloon may retract to the ICA at inflation in the cavernous sinus. Therefore, the balloon or balloons embolization technique may also fail if the fistula is really too small/large or cannot be reached due to its location. Under these circumstances, the ICA may have to be sacrificed in order to treat the CCF. Also, large balloons or multiple balloons occupying the cavernous sinus can cause cranial nerve palsies or delay recovery from preexisting palsies. In addition, incomplete occlusion of the fistulous opening sometimes produces a false aneurysm. Other techniques can be used to treat the CCF while preserving ICA flow, such as 1) transarterial catheterization with a microcatheter and embolization with microcoils[10] and 2) transvenous embolization through the inferior petrosal sinus or through the ophthalmic vein[5]. However, technical pitfalls associated with embolization done with these coils include the impossibility of easy retrieval, the relative stiffness of the coils, the risk of perforation, and the difficulty of packing them tightly. Moreover, complete obliteration of the fistula may be difficult to achieve, and there is a risk of impingement on the parent vessel and pos-

sible distal coil migration. In addition, venous routes are not always accessible while transvenous techniques can be used to treat some of these patients. Occlusion of one venous outflow can redirect the flow into the remaining pathways, causing aggravation of ocular symptoms(superior ophthalmic vein) or hemorrhage(cortical drainage).

Guglielmi detachable coils have been introduced as a method for treating aneurysms that are difficult to manage surgically[4] and have been used widely as an alternative treatment method for obliteration of aneurysmal sac. Advantage of using electrodetachable platinum coils are the ability to control their placement and to easily retrieve, reposition, or exchange them, if necessary[3]. It is also technically easiler to guide a microcatheter/microguidewire combination through a small fistula than it is a balloon. Therefore, failure of a balloon to enter the fistula should not be considered a contraindication but rather an indication to attempt embolization with GDCs. Abrupt thrombosis and closure may be produced with placement of fibered GDCs[8].

An intracavernous venogram should be obtained to verify that the microcatheter is positioned properly and to accurately delineate the cavernous sinus. We believe that the occluding coils should be placed as close to the fistula orifice as possible, leading to a better anatomic result and decreasing the risk of migration. While placement of the coils close to the fistula orifice is desirable, it is associated with a higher risk of coil displacement into the parent artery. A carotid angiogram before detachment through the guiding catheter may be obtained to document the proper position of the coil and the patency of the ICA. In this situation, role of intracranial stent is sometimes important as prevention of migrating coils into parent artery.

Conclusion

We report a stent-assisted GDC embolization for a CCF failed in balloon embolization previously. The balloon embolization technique is a standard method for treating CCFs while preserving a patent parent ICA, but may fail if the fistula is really too small/large or cannot be reached due to its location. Herein, transarterial coil embolization with detachable, retrievable platinum alloy coils of the GDC system may reduce the failure. Additionally, the use of the stent prevents migration of the coils into parent artery.

• **Received** : March 29, 2002
• **Accepted** : May 25, 2002
• **Address for reprints** : Jung Yong Ahn, M.D., Department of Neurosurgery, Bundang CHA Hospital, 351, Yatap-dong, Bundang-gu, Seongnam 463-712, Korea
Tel : 031) 780-5260, Fax : 031) 780-5269
E-mail : jyahn@cha.ac.kr

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